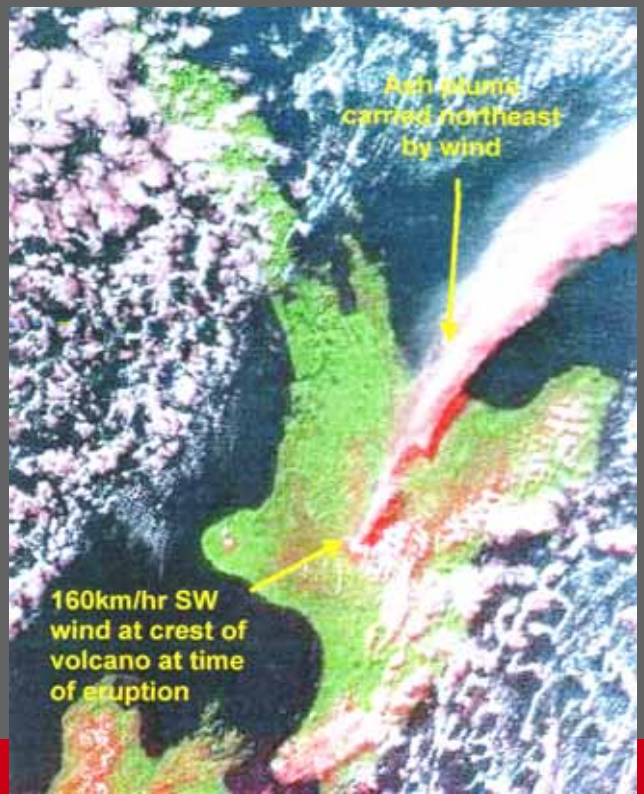
Volcanic Impacts Study Group

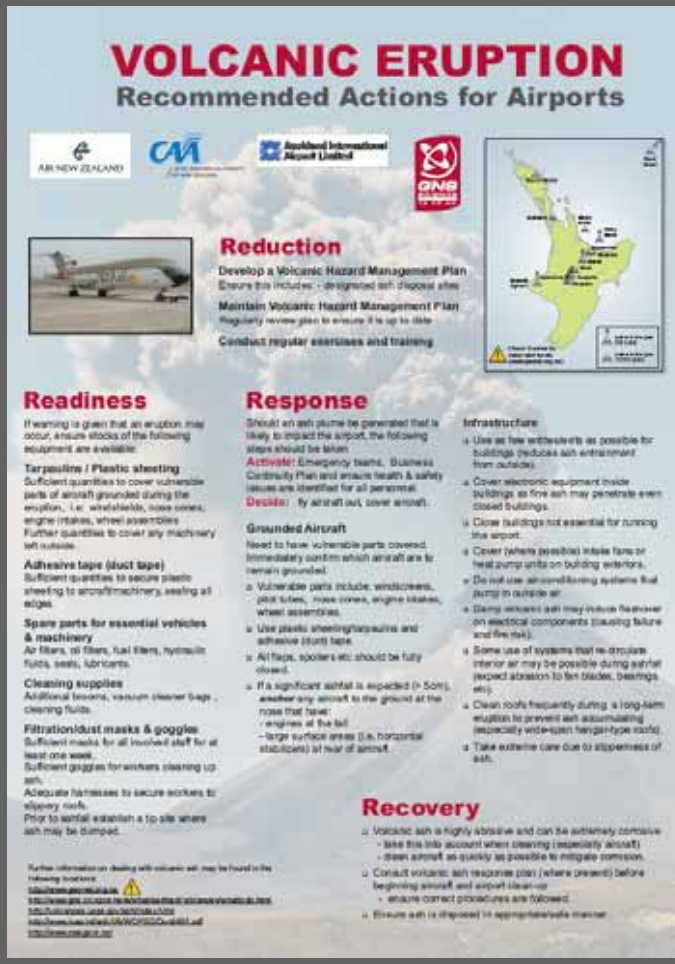
Dr David Johnston,
GNS Science / Massey University

Objectives

- To facilitate improved knowledge about the impacts of volcanic hazards on, and mitigation measures for, lifeline infrastructure.
- To facilitate and support research on the impacts of volcanic hazards on lifelines and development of appropriate mitigation measures,
- To provide input into the applicability for lifelines of any research being undertaken.
- To facilitate reconnaissance investigations to active volcanic areas where this would add to our knowledge about volcanic impacts on infrastructure.
- To provide a national focal point for volcanic impacts work on lifelines (as Wellington currently is for earthquakes).



Sector Analysis:
AIRPORTS



VOLCANIC ERUPTION
Recommended Actions for Airports

Reduction
Develop a Volcanic Hazard Management Plan
Ensure this includes: - designated ash disposal sites

Maintain Volcanic Hazard Management Plan
Regularly review plan to ensure it is up to date

Conduct regular exercises and training

Readiness
If warning is given that an eruption may occur, ensure stocks of the following equipment are available:

Tarpaulins / Plastic sheeting
Sufficient quantities to cover vulnerable parts of aircraft grounded during the eruption, i.e. windshields, nose cones, engine intakes, wheel assemblies
Further quantities to cover any machinery left outside.

Adhesive tape (duct tape)
Sufficient quantities to secure plastic sheeting to aircraft/machinery, sealing all edges.

Spare parts for essential vehicles & machinery
Air filters, oil filters, fuel filters, hydraulic fluids, seals, lubricants.

Cleaning supplies
Additional brooms, vacuum cleaner bags, cleaning fluids.

Filtration/dust masks & goggles
Sufficient masks for all involved staff for at least one week.
Sufficient goggles for workers clearing up ash.
Adequate harnesses to secure workers to slippery roofs.
Prior to ashfall establish a tip site where ash may be dumped.

Response
Should an ash plume be generated that is likely to impact the airport, the following steps should be taken:

Activate: Emergency teams, Business Continuity Plan and ensure health & safety issues are identified for all personnel.

Decide: fly aircraft out, cover aircraft.

Grounded Aircraft
Need to have vulnerable parts covered. Immediately confirm which aircraft are to remain grounded.

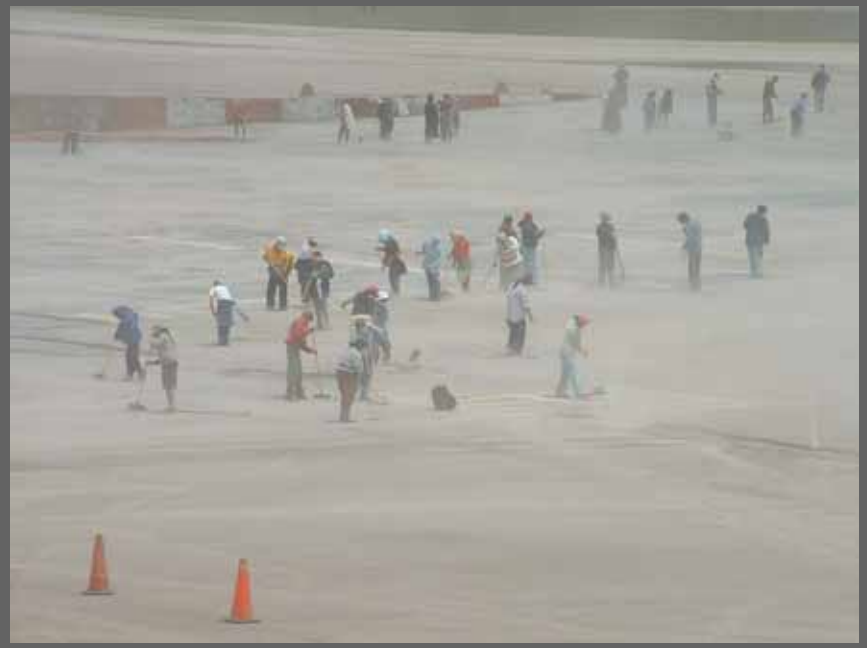
- Vulnerable parts include: windscreens, pitot tubes, nose cones, engine intakes, wheel assemblies.
- Use plastic sheeting/tarpaulins and adhesive (duct) tape.
- Air flaps, spoilers etc should be fully closed.
- If a significant ashfall is expected (> 5cm), ~~another~~ any aircraft to the ground at the nose that have:
  - engines at the tail
  - large surface areas (i.e. horizontal stabilizers) at rear of aircraft.

Infrastructure

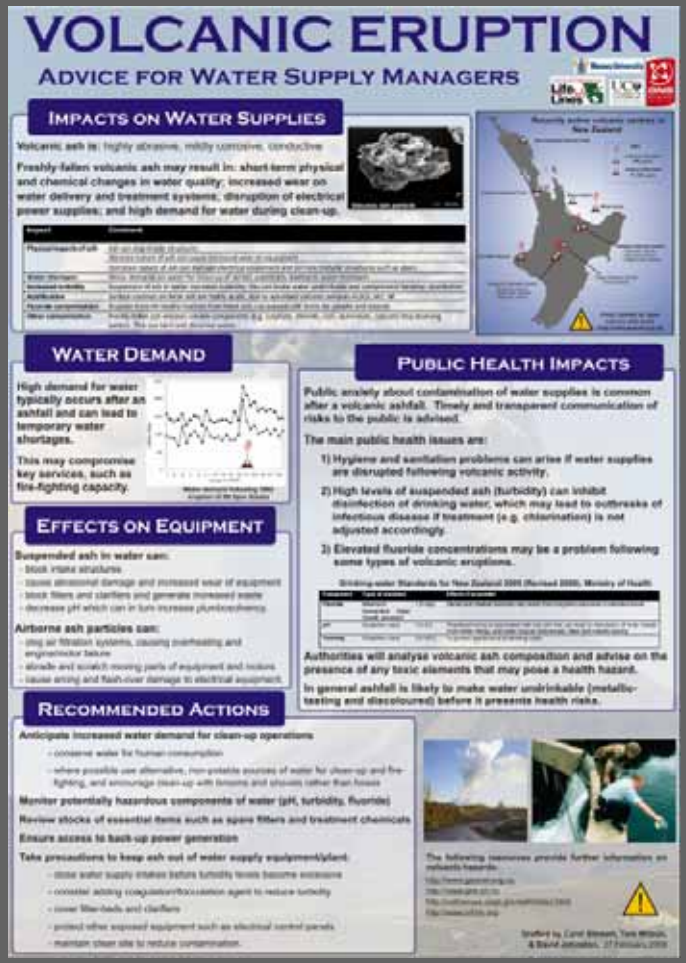
- Use as few entry/exits as possible for buildings (reduces ash entrainment from outside).
- Cover electronic equipment inside buildings as fine ash may penetrate even closed buildings.
- Close buildings not essential for running the airport.
- Cover (where possible) intake fans or heat pump units on building exteriors.
- Do not use air-conditioning systems (fuel pump) to outside air.
- Damp volcanic ash may induce flashover on electrical components (causing failure and fire risk).
- Some use of systems that re-circulate interior air may be possible during ashfall (expect abrasion to fan blades, bearings etc).
- Clean roofs frequently during a long-term eruption to prevent ash accumulating (especially wide-span hangar-type roofs).
- Take extreme care due to slipperiness of ash.

Recovery
- Volcanic ash is highly abrasive and can be extremely corrosive
  - take this into account when cleaning (especially aircraft)
  - clean aircraft as quickly as possible to mitigate corrosion.
- Consult volcanic ash response plan (where present) before beginning aircraft and airport clean-up
  - ensure correct procedures are followed.
- Ensure ash is disposed in appropriate/safe manner.

Further information on dealing with volcanic ash may be found in the following locations:



Sector Analysis:
WATER



Sector Analysis: ROADING

VOLCANIC ERUPTION

RECOMMENDED ACTIONS FOR ROADING MANAGERS

VOLCANIC ASH

Ash dispersal is dependant on prevailing wind direction

Silt to sand size, highly Abrasive, mildly Corrosive, potentially Conductive
- May be ingested into engines, blocking filters and abrading the engine and other mechanical parts
- Ash may contaminate areas for extended periods of time (doesn't melt like snow), and its fine grainsize can make it difficult to handle compared to sand
- Thick ashfalls may create extra loadings on bridges (wet ash is very heavy)

Driving Hazards
- Easily re-mobilised by wind, water, and fast moving vehicles
- Driving Hazards - slippery surfaces, covers road markings, poor visibility during ashfall
- Respiratory hazard (easily ingested by humans and animals)

Volcanic centres in New Zealand

Volcanic ash particle

REDUCTION

Volcanic eruptions may have a rapid onset, so emergency planning needs to be done well in advance

Develop a Volcanic Hazard Management Plan
- Identify a hierarchy of roads for priority of clean-up. Ensure this includes designated ash disposal sites and considers road closures.
- Ensure road maintenance equipment is undercover.

Maintain Volcanic Hazard Management Plan
- Regularly review plan to ensure it is up to date.

READINESS

Prior to an eruption (i.e. periods of volcanic unrest), ensure that there are stocks of the following equipment:
- Spare parts for essential road maintenance vehicles *(air filters, oil filters, fuel filters, lubricants hydraulic fluids, seals, etc.)*
- Safety plan & equipment for personal *(masks, goggles - sufficient for all staff)*
- Adequate water supply for damping down ash to reduce re-mobilisation (ideally not domestic water supply)
- Facilities for cleaning maintenance vehicles
- Establish ash disposal site (in consultation with Territorial Local Authority)

Clearing roads following ashfall in Catania, Italy during the 2002 Etna eruption (S. Barnard)

Collecting ash from roads in Yakama, Washington, United States following the 1980 Mt St Helens eruption

RESPONSE

ACTIVATE:
- **emergency plan**
- **health and safety plan**
- **identify priority roads for clearance**
- **monitor eruption information (www.geonet.org.nz)**
- **monitor weather conditions** *(determines where ash will be deposited)*

Ensure staff are well briefed on ash removal and safety aspects
- Be prepared to distribute information to other road users on best practices

Closely monitor performance maintenance vehicles and health of staff

RECOVERY

Equipment should be cleaned as often as possible to mitigate damage

Ensure ash is disposed of in an appropriate manner

An on-going eruption & re-mobilised ash may continue to re-contaminate roads long after the eruption
- plan for long term management of ash clearance and disposal from sediment capture devices
- long term supply arrangements of protective and spare parts may be required

Further information on dealing with volcanic ash may be found in the following locations:

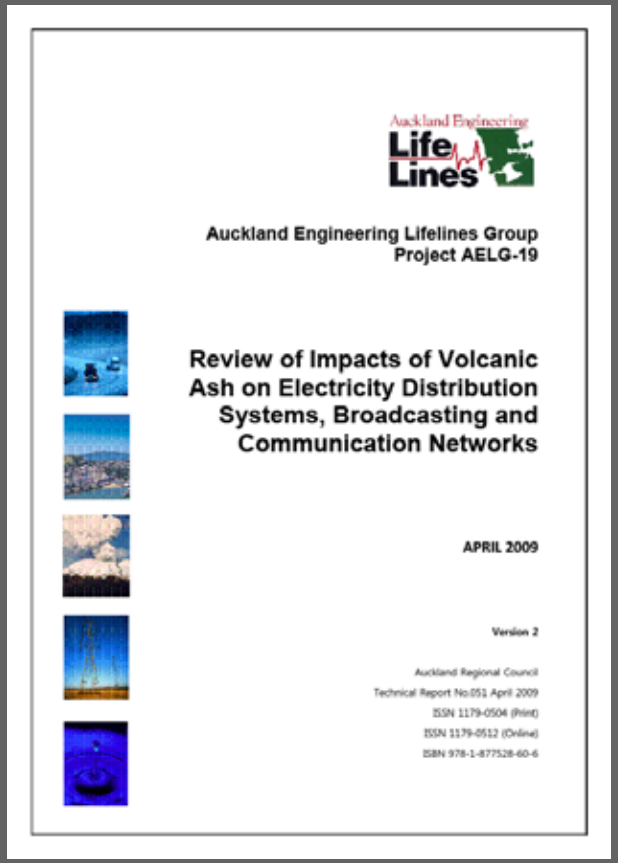
http://www.geonet.org.nz
http://www.gns.cri.nz/ce.here/what/earthact/volcanoes
http://volcanoes.usgs.gov/ash/index.html
http://www.ivhhn.org

AELG – 19
Electricity, telecommunications & broadcasting

1. To summarise the information and research undertaken (nationally and internationally) on the impacts of volcanic ash on **electricity distribution systems, broadcasting** and **communication networks**.

2. To identify **vulnerable components** of electricity, broadcasting, radio transmission and communications networks to ash.

3. To identify **mitigation measures** to reduce vulnerability prior to a volcanic event, and measures to reduce damage during and post event.



VOLCANIC ERUPTION

ADVICE FOR ELECTRICITY NETWORK MANAGERS

ASH IMPACTS ON ELECTRICITY DISTRIBUTION

Volcanic ash is: hard, highly abrasive, mildly corrosive and conductive.

Volcanic ashfalls can cause disruption to electricity supplies in the following ways:

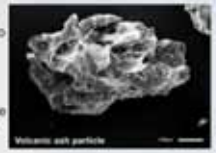
- Ashfall buildup on insulators can lead to flashover (the unintended disruptive electric discharge over or around the insulator), causing disruption to distribution networks.
- Line breakages and damage to towers and poles due to ash loading, both directly onto the structures and by causing treefall onto lines, particularly in heavy, fine ashfall events. Snow and ice accumulation on lines and vegetation will exacerbate the risk
- Breakdown of substation and control equipment such as air conditioning/cooling systems due to ash penetration which can block air intakes and cause corrosion.
- Controlled outages during cleaning.

Of these, the main hazard is insulator flashover. Volcanic ashfall may also increase electrocution risks (by increasing touch potentials) to workers in substations.

INSULATOR FLASHOVER

Factors contributing to risk of flashover include:

- Light wet weather conditions (dew, fog, drizzle or light rain) wets the ash and leads to a conductive layer forming on the surface which initiates leakage current and leads to arcing and flashover. Heavier rain will wash off contaminants.
- Ash grainsize (fine ash adheres to insulators more strongly).
- Presence of other contaminants e.g. sea salt, dust, agricultural sprays, smoke.
- Elapsed time since last maintenance.
- Insulator design and construction (ability to shed ash and resist acidic corrosion).



ELECTROCUTION RISK

Resistivity of ground gravel cover may reduce following ashfall, reducing step potential and possibly increasing touch potentials.

RISK OF LINE AND SUBSTATION INSULATOR FLASHOVER

Risk factors		Probability of failure			
Line voltage	Ash moisture content	Ash thickness <5 mm		Ash thickness >5 mm	
		Fine ash	Coarse ash	Fine ash	Coarse ash
<33 kV (domestic)	Wet	High	Low	High	Medium
	Dry	Low	Low	Low	Low
>33 kV (regional-national)	Wet	Medium	Low	High	Medium
	Dry	Low	Low	Low	Low

RISK OF DAMAGE TO TOWERS, POLES AND LINES

	Weather conditions	Ash thickness <100 mm		Ash thickness >100 mm	
		Fine ash	Coarse ash	Fine ash	Coarse ash
Towers and poles	Wet	Low-medium	Low	Medium-high	Low
	Dry	Low	Low	Medium	Low
Lines	Wet	Low-medium	Low	High	Low-medium
	Dry	Low	Low	Medium	Low

RECOMMENDED ACTIONS

Substations

- Prior to an ashfall, maintain insulators in a clean condition, especially in coastal areas
- During an ashfall, monitor buildup of ash on insulators. If conditions are wet, consider controlled outages to allow cleaning.
- Immediately after an ashfall, dispatch personnel to substations to dust, sweep and blow ash from electrical equipment, and clean roofs and gutters.
- Be aware of increased electrocution hazard if ashfall covers the ground. Isolate substations or electrical equipment before entering site.

Line insulators

- Maintain line insulators in a clean condition, especially in coastal areas.
- During an eruption, monitor buildup of ash on insulators.
- Make controlled cuts if necessary to clean insulators, or replace damaged insulators. Ensure all surfaces are cleaned, including underneath. Cost-benefit analysis will dictate whether cleaning or total replacement is appropriate.

Towers, poles and lines

- Maintain in a good state of repair, in particular ensure that lines are kept free of overhanging branches.
- During an eruption, continually monitor the network for ash accumulation on towers, lines, poles and overhanging branches.
- Replace or repair damaged components as appropriate.

General notes on cleanup of ash

- Remove dry ash from the most sensitive systems by blowing it off using air pressure of 30 psi or less, to avoid a sandblasting effect.
- Avoid rubbing or brushing equipment. Remove ash by vacuuming if possible.
- Regularly clean and/or replace vehicle and air-conditioning filters (stock spares)
- To avoid eye and respiratory irritation wear face masks and goggles
- Consider acquiring cleanup equipment (water blasters, air compressors)

The following resources provide further information on volcanic hazards:

http://www.geonet.org.nz
http://volcanoes.usgs.gov/ash/index.html
http://www.ivhhn.org
http://www.avlg.org

Drafted by Tom Wilson, Carol Stewart & David Johnston. 26 August 2009